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PRIORITY: ITALIAN APPLICATION No. BO2002A000579

FILED: SEPTEMBER 13, 2002

TITLE: DEVICE AND METHOD FOR MACHINING CONNECTING RODS, AND CONNECTING RODS SO PRODUCED

## TITLE OF THE INVENTION:

DEVICE AND METHOD FOR MACHINING CONNECTING RODS, AND CONNECTING RODS SO PRODUCED

The present invention relates to a device for machining connecting rods.

The present invention may be used to advantage for machining low casehardened steel connecting rods, to which the following description refers purely by way of example.

## BACKGROUND OF THE INVENTION

Here and hereinafter, low case hardened steel connecting rods are intended to mean connecting rods made of case hardened steel with a case depth of less than eight millimetres.

Connecting rods made of low case hardened steel have been proposed to enable them to better withstand the stress imposed by modern combustion engines.

Machining low case hardened steel connecting rods, however, poses various problems, owing, in particular, to the relatively high residual "ductility" of this type of material.

A connecting rod normally comprises a rod, and a big end in turn comprising an eye bounded by an inner annular surface of the big end. To fit the connecting

rod to the engine and so insert the crankshaft through the eye, the big end is normally divided into two portions, a first of which remains attached to the rod, and the second of which is separated to form the so-called cap.

The big end is normally cut or, preferably, broken by traction into the two portions.

Since the cap must eventually be reconnected to the first portion at assembly, the contact surfaces between the cap and the first portion must mate as accurately as possible to reduce the formation, during operation of the engine, of stress and/or deformation which may damage the connecting rod or other parts of the engine.

For this reason, the break must be as "fragile", i.e. result in as little inelastic deformation, as possible. In which connection, it is important to note that any deformation, even not in the area of the break, may still promote failure and stress during operation of the engine.

The break is normally made using a device comprising two traction members, which, in use, are inserted inside the eye and pulled apart to detach the cap from the first portion of the big end. The traction members have respective thrust surfaces in the form of a cylindrical sector, and which mate with said annular surface and have substantially identical angles of

curvature.

Though long used for machining connecting rods of relatively high-carbon steel, attempts so far to apply the above device to low case hardened steel connecting rods have resulted in breaks of relatively poor "fragility" and therefore in parts substantially unsuitable for use in modern combustion engines.

**SUMMARY OF THE INVENTION**

It is an object of the present invention to provide a device for machining steel connecting rods, designed to eliminate the aforementioned drawbacks, and which at the same time is cheap and easy to produce.

According to the present invention, there is provided a device for machining steel connecting rods, as claimed in Claim 1.

The present invention also relates to a method of machining steel connecting rods.

According to the present invention, there is provided a method of machining steel connecting rods, as claimed in Claim 8.

The present invention also relates to a steel connecting rod.

According to the present invention, there is provided a low case hardened steel connecting rod, as claimed in Claim 15.

**DETAILED DESCRIPTION OF THE INVENTION**

A non-limiting embodiment of the invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a plan view of a connecting rod in accordance with the present invention;

Figure 2 shows a longitudinal section of a detail of the Figure 1 connecting rod;

Figure 3 shows a plan view of a connecting rod from which to form the Figure 1 connecting rod;

Figure 4 shows a view in perspective, with parts removed for clarity, of one embodiment of the device according to the present invention;

Figure 5 shows a lateral section of the Figure 4 device;

Figure 6 shows a plan view of parts of the Figure 4 device.

## DETAILED DESCRIPTION OF THE INVENTION

With reference to Figures 1 and 2, number 1 indicates as a whole a low case hardened steel connecting rod comprising a rod 2; and a big end 3 in turn having a cylindrical opening or eye 4, which has a longitudinal axis 4a substantially crosswise to rod 2, is defined laterally by an annular surface 5, and houses a portion of a crankshaft.

Big end 3 is divided into two portions: a first portion 6 integral with rod 2; and a removable cap 7.

First portion 6 is saddle-shaped and forks into two legs 8, each having a respective end 9; and cap 7 is also saddle-shaped, and forks into two legs 10, each having a respective end 11.

Each end 9 is gripped to a respective end 11 by a relative bolt 11a, so that portion 6 and cap 7 define eye 4. Big end 3 also comprises two notches 12 formed at the outer edges of ends 9 and 11 and extending parallel to axis 4a.

In variations not shown, notches 12 may be formed at the bottom and/or top inner edges of ends 9 and 11.

Ends 9 and 11 include surfaces lying in two break planes 13 and 14 and formed by "fragile" breakage of a connecting rod 15 (Figure 3) on which notches 12 are formed beforehand. Break planes 13 and 14 are coplanar, and lie substantially in a diametrical plane (not shown) of eye 4 substantially crosswise to rod 2 and through notches 12.

In further embodiments not shown, break planes 13 and 14 may be at an angle to each other and/or need not lie in said diametrical plane.

Connecting rod 15 (Figure 3) is substantially identical with connecting rod 1, the only difference being that big end 3 has no notches 12 and is formed in one piece, i.e. with portion 6 integral with cap 7.

With reference to Figures 4 and 5, number 16

indicates as a whole a device for producing connecting rod 1 from connecting rod 15, and which comprises a rectangular parallelepiped-shaped bed 17 supporting two uprights 18 and 19 at opposite ends. Uprights 18 and 19 are substantially parallelepiped-shaped and connected by a horizontal guide 20 comprising two slide cylinders 21 (only one shown) extending longitudinally with respect to bed 17.

Upright 18 is defined at the top by a supporting surface 22 for supporting rod 2 and first portion 6, and which has a fixed traction pin 23 in the form of a vertical half-cylinder. Traction pin 23 is inserted inside eye 4 and is defined laterally by a thrust surface 24 in the form of a cylindrical sector and which mates with annular surface 5 of first portion 6.

Device 16 also comprises a slide 25 movable along horizontal guide 20 and having a seat 26 for housing cap 7. Seat 26 has a supporting surface 27 substantially coplanar with surface 22 and for supporting cap 7, and is fitted with a traction pin 28 in the form of a vertical half-cylinder.

Traction pin 28 is fitted integrally to slide 25, is inserted inside eye 4, and is defined laterally by a thrust surface 29 in the form of a cylindrical sector and which mates with annular surface 5 of cap 7.

As shown clearly in Figure 6, thrust surface 24 has

a smaller radius of curvature than thrust surface 29. In preferred embodiments, the radius of curvature of annular surface 5 is greater than or equal to that of thrust surface 29. More specifically, the radius of curvature of annular surface 5 preferably ranges between 100% and 110% of the radius of curvature of thrust surface 29.

Preferably, the radius of curvature of thrust surface 24 ranges between 80% and 99%, in particular between 92% and 98%, of the radius of curvature of thrust surface 29. Particularly preferred embodiments are those in which the radius of curvature of thrust surface 24 is 97% of the radius of curvature of thrust surface 29.

Device 16 also comprises an actuating unit 30 for parting traction pins 23 and 28, and which comprises two horizontal hydraulic cylinders 31 connected at the front to slide 25 by means of a flange 32, and supported at the rear by a bracket 33 fitted to upright 19.

Device 16 also comprises a known laser source 34 (shown schematically) for making notches 12.

In actual use, connecting rod 15 is positioned so that traction pins 23 and 28 are inserted inside eye 4, cap 7 is housed inside seat 26, and rod 2 is supported on surface 22 and oriented substantially parallel to horizontal guide 20.

To increase the fragility of the low case hardened steel of connecting rod 15, connecting rod 15 is preferably cooled using known methods, e.g. by immersing it in liquid nitrogen before it is set up on the device.

Once connecting rod 15 is set up, laser source 34 is activated by a control unit 35 (shown schematically in Figure 4) to form notches 12.

At this point, actuating unit 30 is operated (also by control unit 35) to move slide 25 towards upright 19. At the same time, traction pins 23 and 28 are parted in a direction substantially parallel to rod 2, and thrust surfaces 24 and 29 mate with annular surface 5 until "fragile" breakage of big end 3 along break planes 13 and 14 is achieved.

In this connection, it should be pointed out that, during traction by traction pins 23 and 28, the particular geometric configuration of traction pins 23 and 28 provides for a relatively high concentration of mechanical stress in break planes 13 and 14. In particular, being connected to rod 2, first portion 6 is more rigid than cap 7, thus reducing inelastic deformation of big end 3 and, in particular, end surfaces 9 and 11.

Once cap 7 is detached from big end 3, connecting rod 1 can be machined, e.g. ground and lapped, in known manner.